



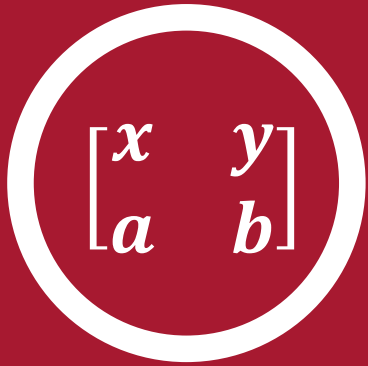
# Allowing for Changes in the General Business Environments in Claims Reserves

Lukas Ehlers

Shuaib Ghoor



**Enhancing Triangulation  
Reserving**

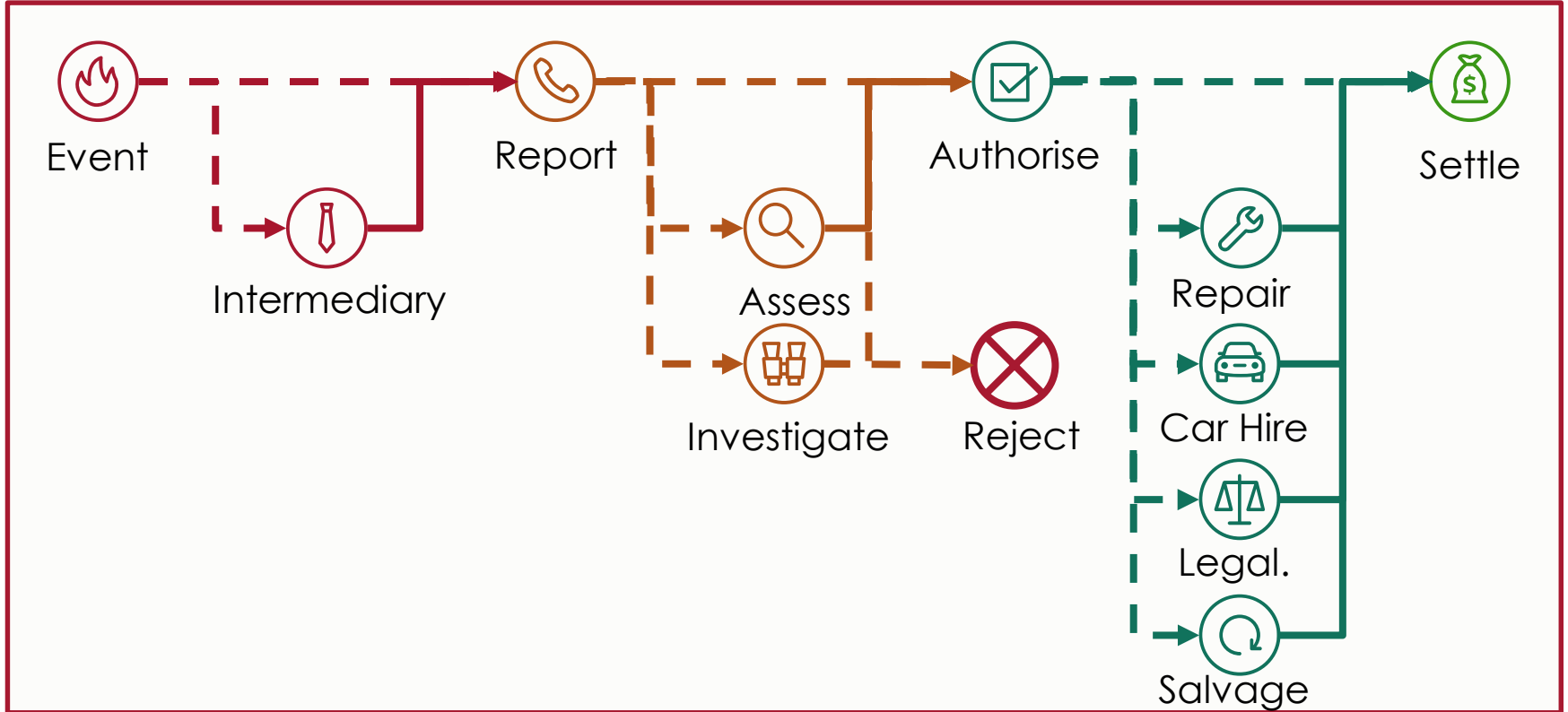


**Replacing Triangulation  
Reserving**

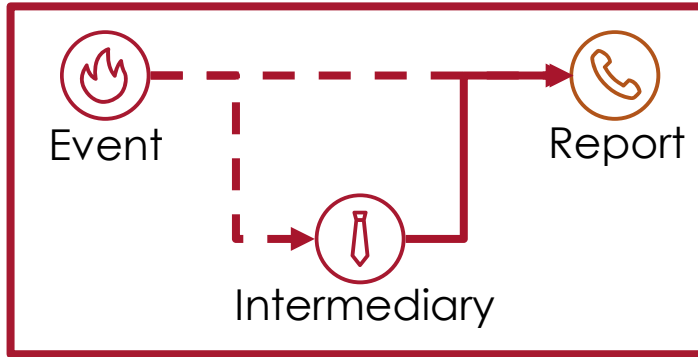
# Claim Process Drivers



# Claim Journey



# Reporting Delay



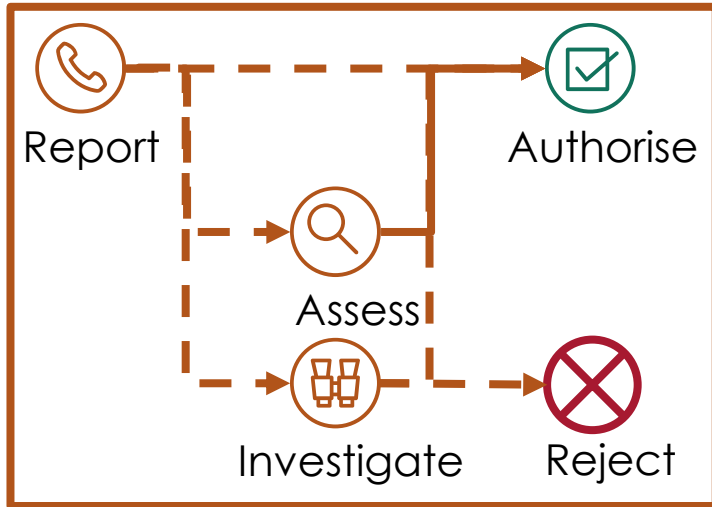
## Cost Raised:

- IBNR

## Dependent on:

- Time of year
- Peril
- Severity
- Type of asset
- Operational changes

# Authorisation Delay



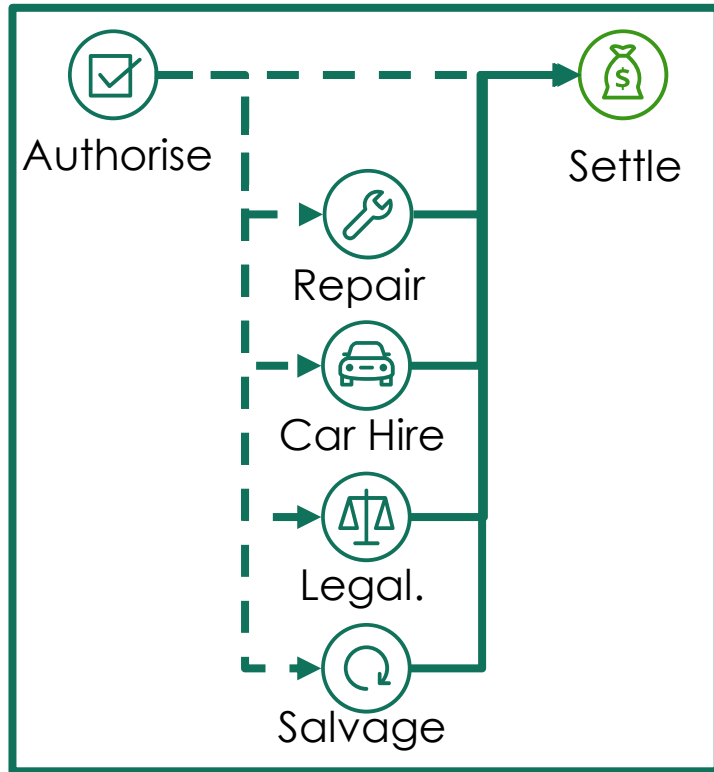
## Dependent on:

- Time of year
- Peril
- Severity
- Type of asset
- Operational changes

## Costs Raised:

- Assessor's fees
- Investigator's fees
- Global estimate
- IBNER

# Settlement Delay



## Dependent on:

- Severity
- Asset Type
- Type of Claim
- Provider
- Systems
- Operational changes

## Costs Raised:

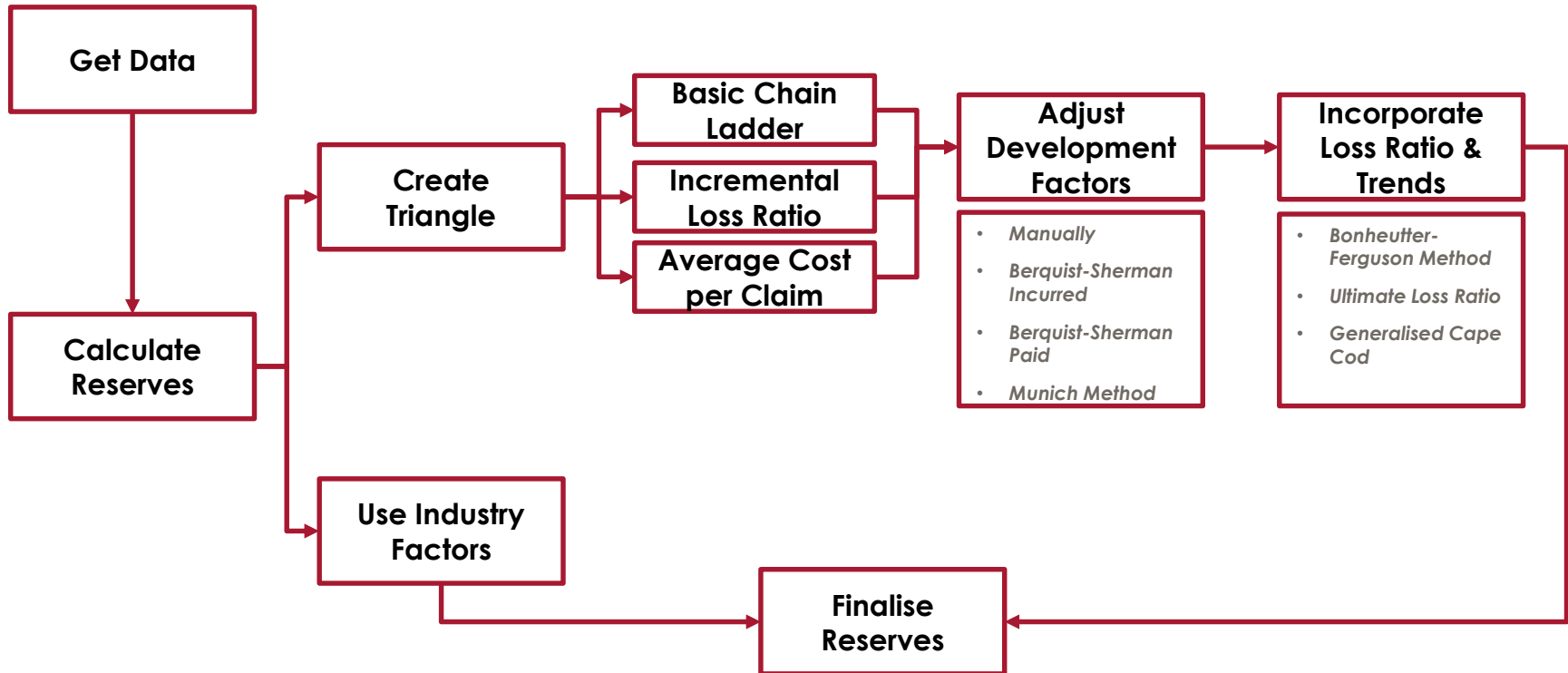
- Case estimate
- IBNER

# The Current State of Reserving in South Africa





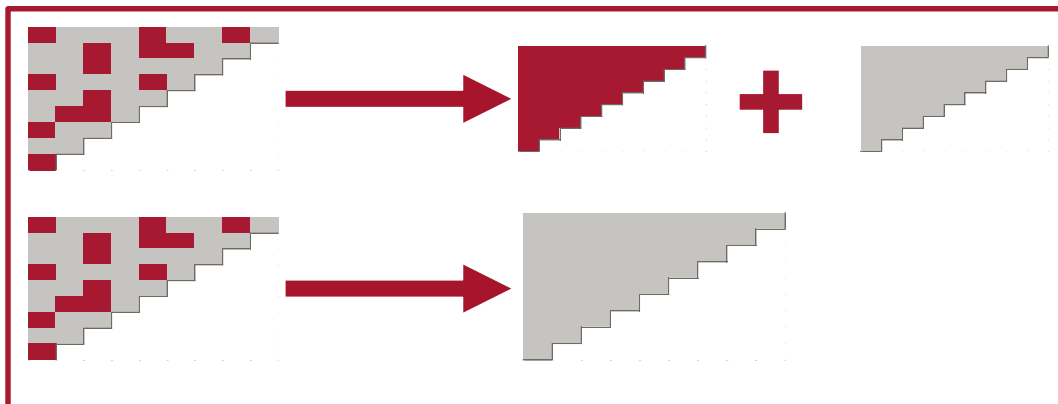
# Short-Term : Models and Analysis



# Heterogeneity

Three biggest sources:

- Lines of Business
- Claim Types
- Claim Amount
  - Attritional
  - Large losses
  - Catastrophes

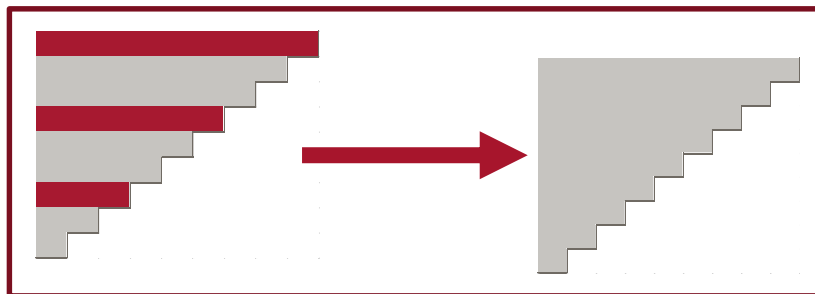


# Seasonality

## Origin period Impact

Driven by exposure:

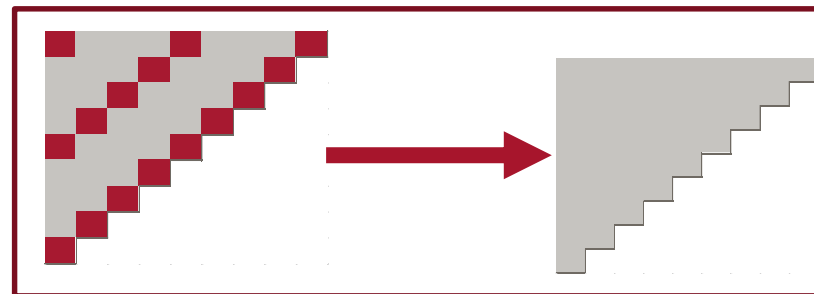
- Weather claims
- Catastrophes



## Calendar Impact

Driven by non-exposure factors:

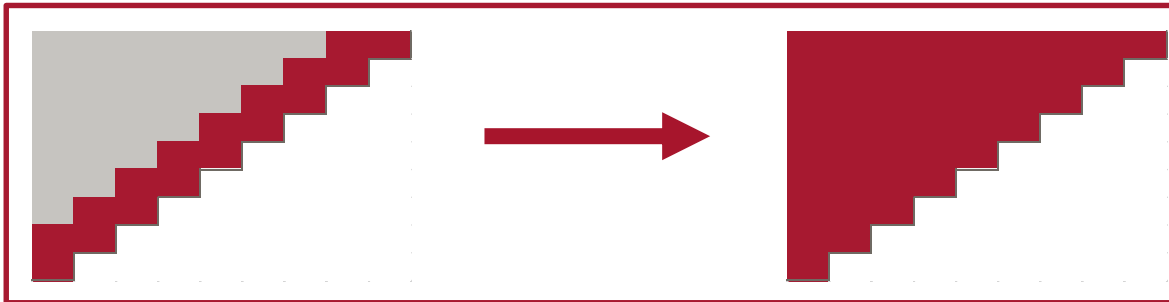
- Holiday Periods
- Financial Year-End
- Capacity



# Operational Changes

Changes would include:

- Process
- Suppliers
- Software platform
- Settlement process



# Too much for triangles

## **Development Period Impact:**

- Mix of Claims
- Claim Reporting Delays
- Inflation Rate
- Inflation per Claim Type
- Claim Size Distribution
- Open / Paid Claims Correlation
- Claims Platform
- Claims Process

## **Origin Period Impact:**

- Mix of Business
- Mix of Claims
- Benefit Changes
- Estimate Changes
- Process Changes
- Catastrophes / Aggregation of Losses

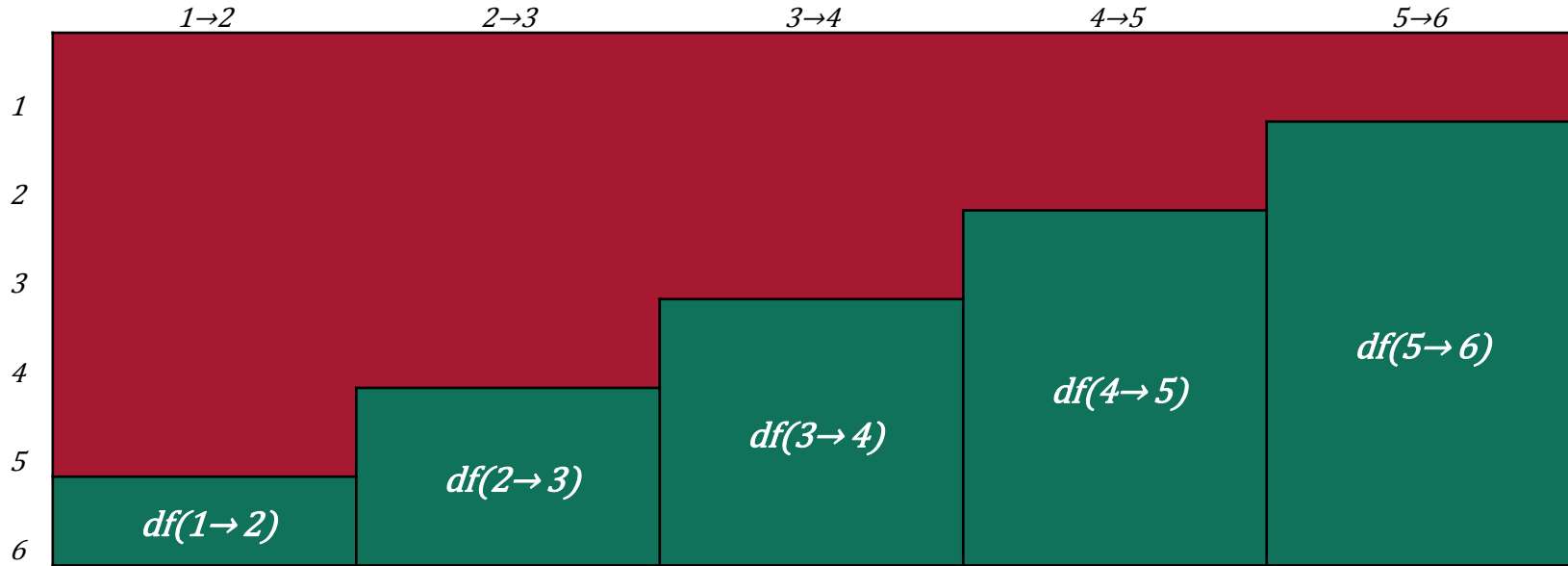
## **Calendar Period Impact:**

- System changes
- Staffing changes
- Capacity Changes
- Change in claim sizes for all open claims (e.g. large change in inflation, court ruling)

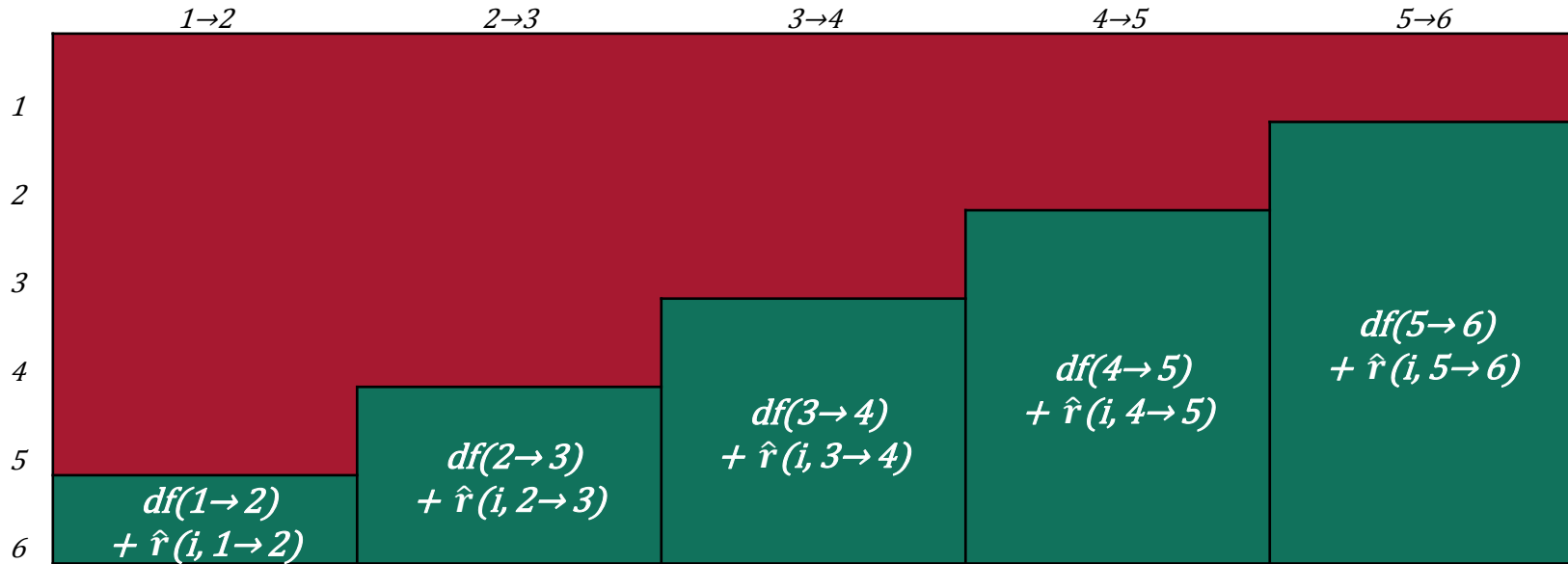
# Method 1: Triangles Residuals



# Current Triangle Assumptions



# Proposed Model



$\hat{r}(i, j \rightarrow j+1) = f(\text{Origin Attributes}, \text{Development Attributes}, \text{Exposure Attributes}, \text{Claim Attributes})$



# Model Structure

## Standardised Residuals

$$Z_{i,j} = \frac{df(i, j \rightarrow j + 1) - df(j \rightarrow j + 1)}{\sigma(j \rightarrow j + 1)}$$

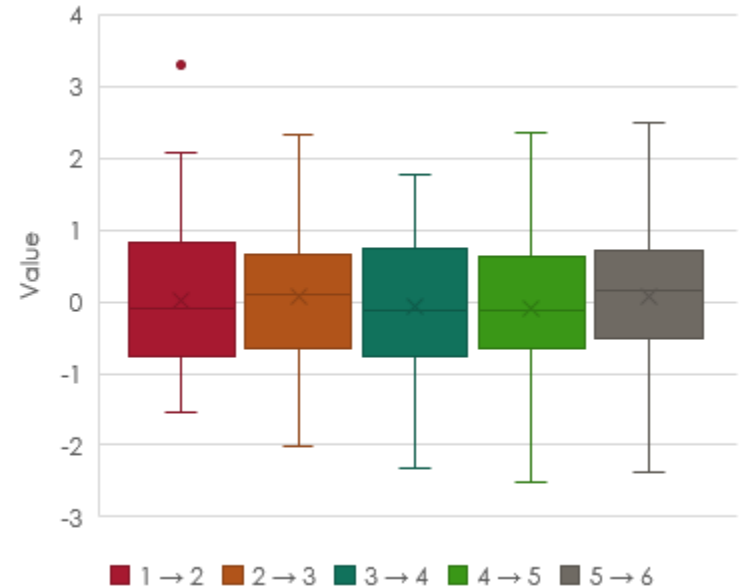
$$Z_{i,j} \sim N(0, 1)$$

## Expected Development Factor

$$\widehat{df}(i, j \rightarrow j + 1) = df(j \rightarrow j + 1) + \sigma(j \rightarrow j + 1) \hat{z}_{i,j}$$

$$\hat{z}_{i,j} = \mu = f(\text{Claims Attributes})$$

## Distribution of Standardised Residuals



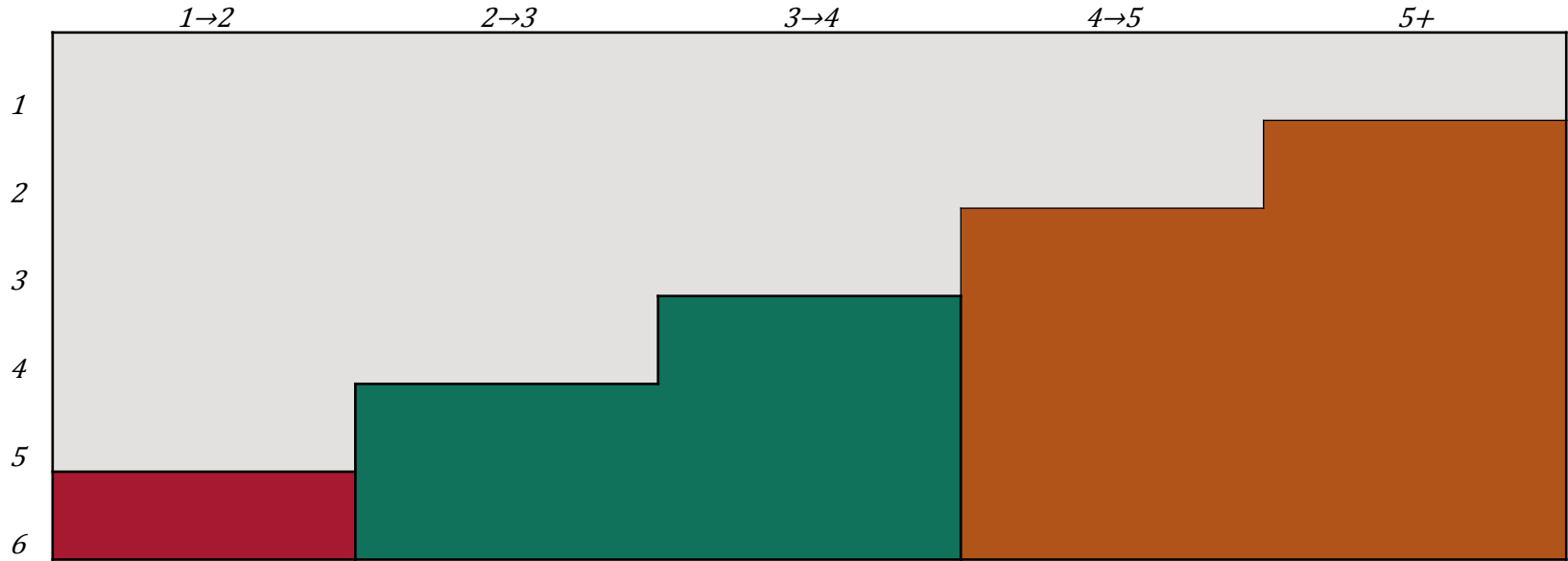
## 1 Process

1. Get data
2. Create triangle
3. Calculate development factors
4. Calculate standardised residuals

- 3 1. Identify significant factors
2. Identify development period groups
3. Fit a linear model
4. Repeat

- 2 1. Enrich data
  1. Peril distribution
  2. Average claim age
  3. Percentage paid
  4. Etc.
2. Standardised these across development periods

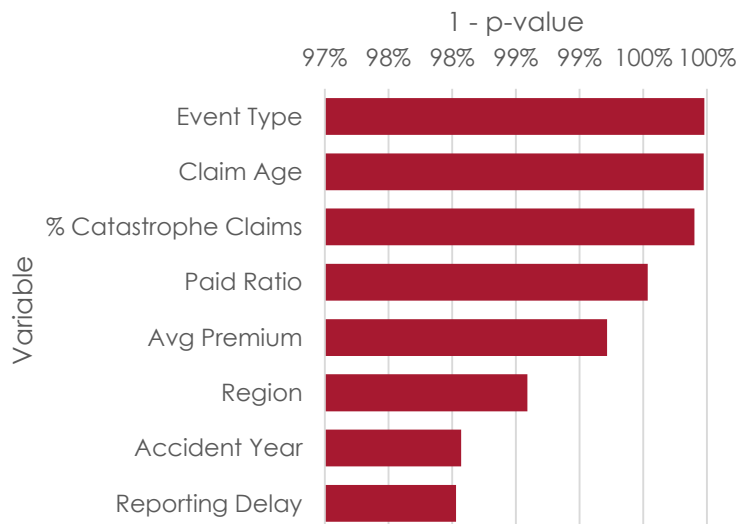
# Model Structure



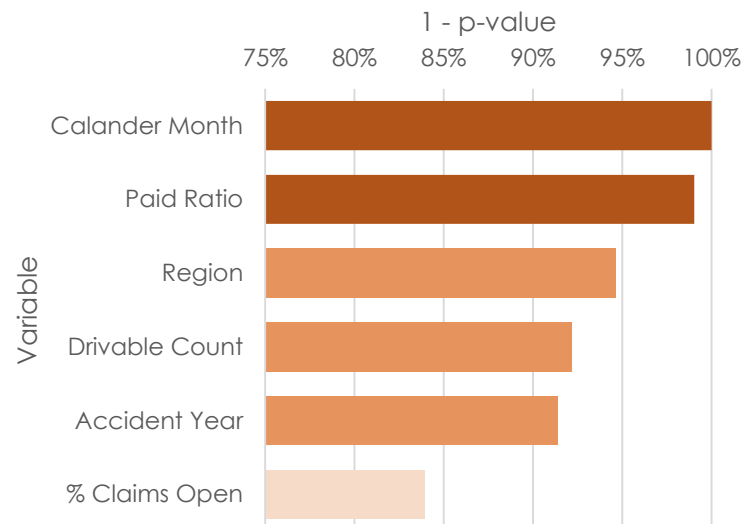
$$\hat{r}(i, j \rightarrow j+1) = f(\text{Origin Attributes}, \text{Development Attributes}, \text{Exposure Attributes}, \text{Claim Attributes})$$

# Model Parameters

Development Period = 1 → 2



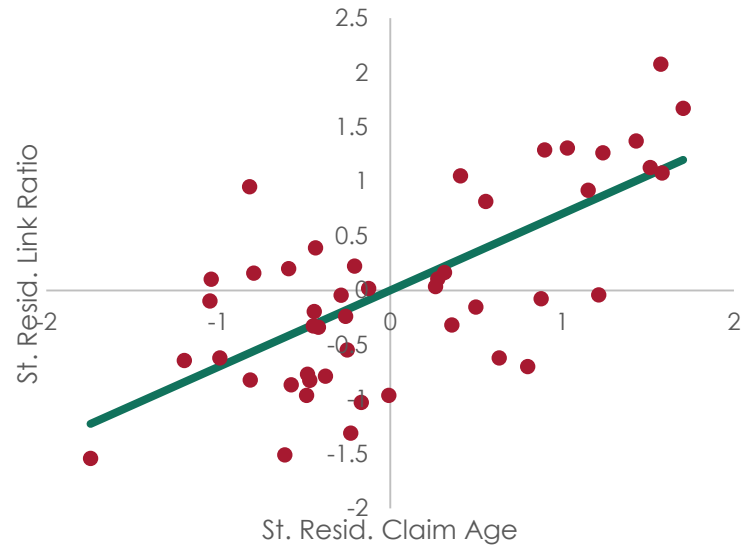
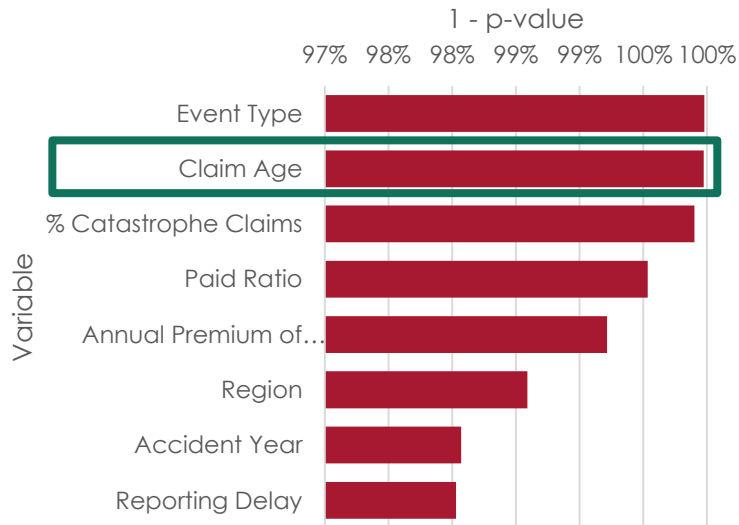
Development Period = 4 +



# Model Parameters: Claim Age

Development Period = 1 → 2

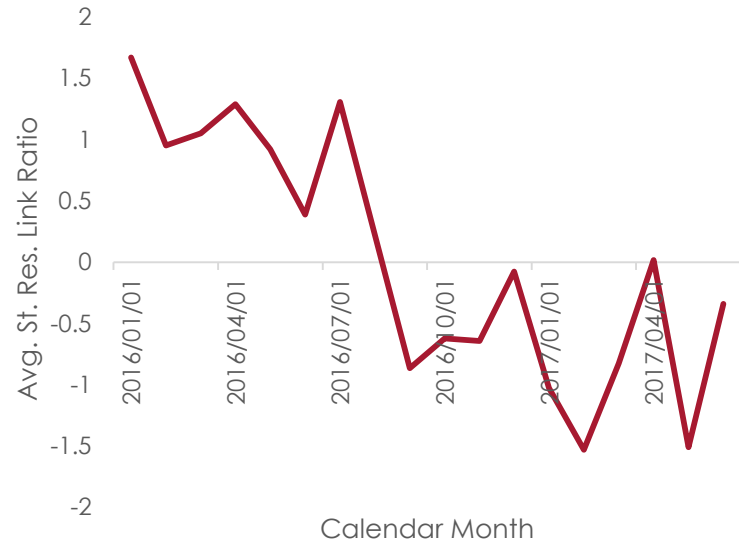
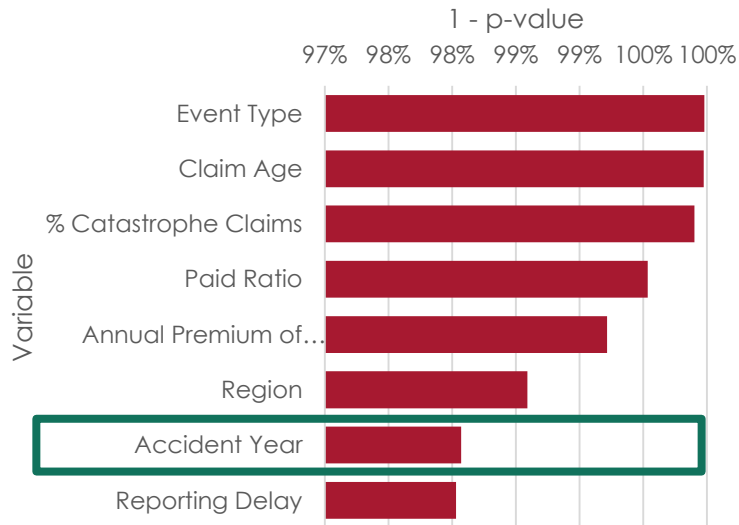
Correlation with Claim Age



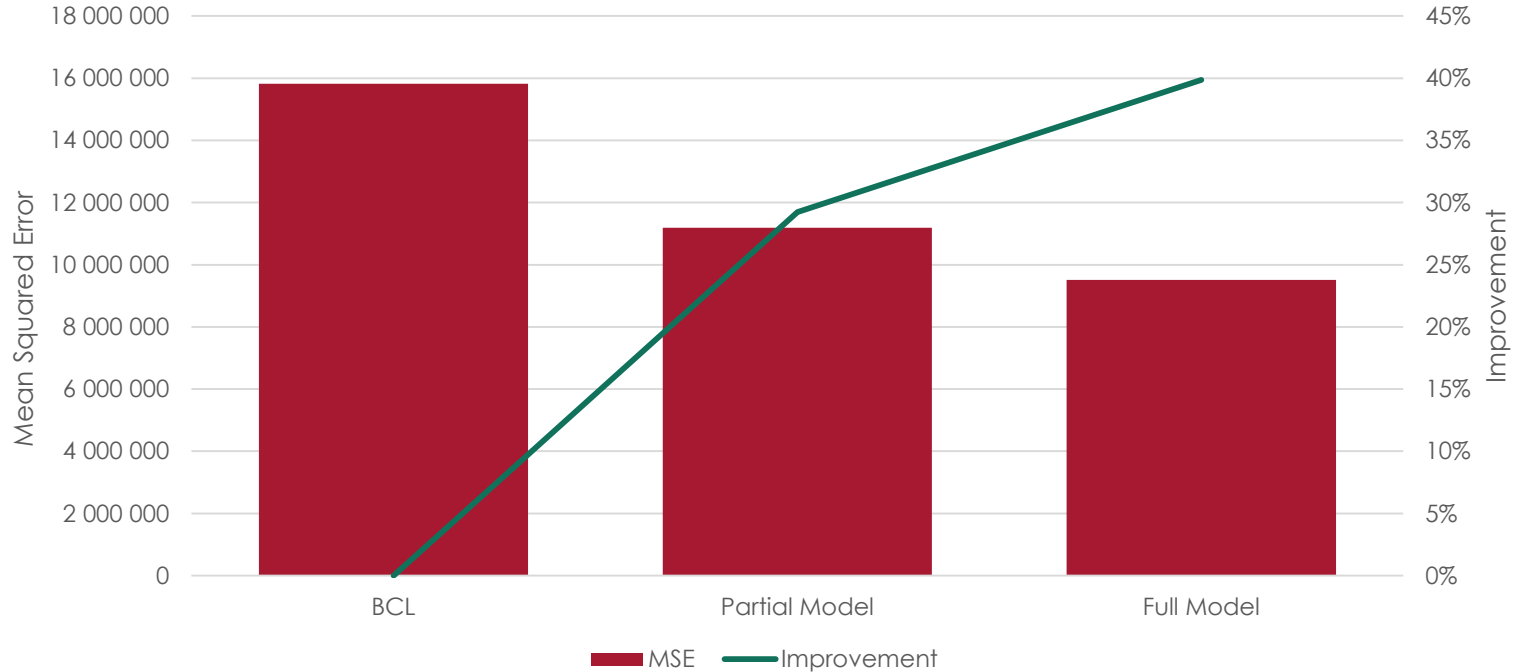
# Model Parameters: Accident Year

Development Period = 1 → 2

Accident Year Impact



# Results



# Benefits of the Approach

## ⊕ Advantages

- Increased Accuracy
- Objectively quantifiable application of professional judgement
- Flexibility
- Gain additional insight w.r.t. drivers of claims
- Reduced Variability = Reduced Risk Margin
- Established methodology

## ⊖ Drawbacks

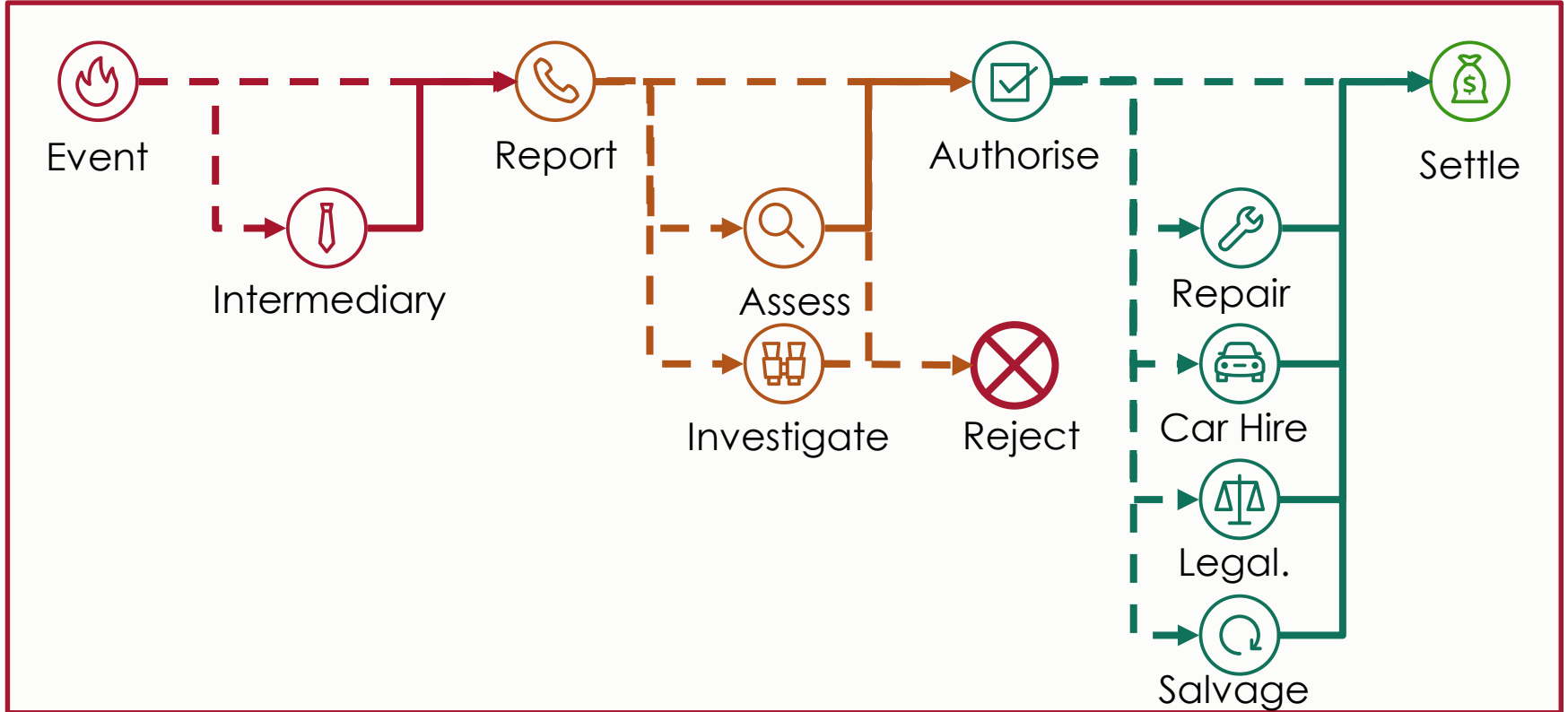
- Initial time and effort required
- Finding significant factors quite difficult
- Overfitting
- Insight needed








# Method 2: State Estimates

$$\begin{bmatrix} x & y \\ a & b \end{bmatrix}$$

# Claim Journey



# Mathematical Claim Journey

	No Claim	Claim 	Reported 	Authorised 	Rejected 	Settled 
No Claim	$NC \rightarrow NC$	$NC \rightarrow C$				
Claim		$C \rightarrow C$	$C \rightarrow R$			
Reported			$R \rightarrow R$	$R \rightarrow A$	$R \rightarrow Rej$	
Authorised				$A \rightarrow A$	$A \rightarrow Rej$	$A \rightarrow S$
Rejected					$Rej \rightarrow Rej$	$Rej \rightarrow S$
Settled						$S \rightarrow S$

# Overview of Process



Unreported Claims



+ Reported but not Authorised Claims



+ Authorised but not Settled Claims



# Overview of Process



Unreported Claims



$$\sum_{Days} \sum_{Perils} (E(\text{Unreported Claims} | Days, Peril) \times E(\text{Claim Amount} | Days, Peril))$$



+ Reported but not Authorised Claims



$$\sum_{Claims} E(\text{Claim Amount} | Peril)$$



+ Authorised but not Settled Claims



$$\sum_{Claims} (\text{Case Estimate}) \times E(\Delta \text{ from Estimate} | Peril)$$

# Overview of Process



Unreported Claims



$$\sum_{Days} \sum_{Perils} (E(\text{Unreported Claims} | \text{Days, Peril}) \times E(\text{Claim Amount} | \text{Days, Peril}))$$



+ Reported but not Authorised Claims



$$\sum_{Claims} E(\text{Claim Amount} | \text{Peril})$$

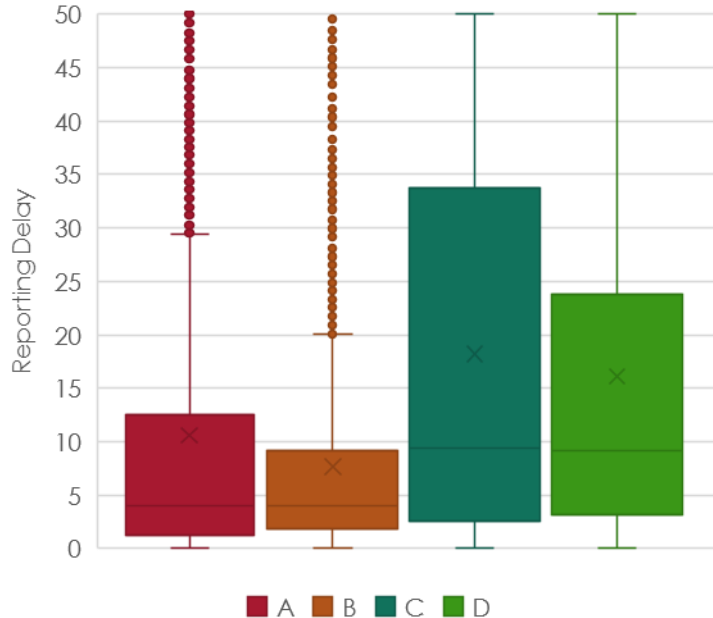


+ Authorised but not Settled Claims



$$\sum_{Claims} (\text{Case Estimate}) \times E(\Delta \text{ from Estimate} | \text{Peril})$$

# Number of Unreported Claims



*Reporting Delay*  $\sim$  *POIS*( $\lambda$ )

$$\lambda = \exp(\eta)$$

$$\eta = f(\text{Peril}, \text{Month}, \text{Calendar Period})$$

$$\text{Reported} = F(\text{Days}) \times (\text{Total})$$

$$\text{Reported} = F(\text{Days}) \times (\text{Reported} + \text{Unreported})$$

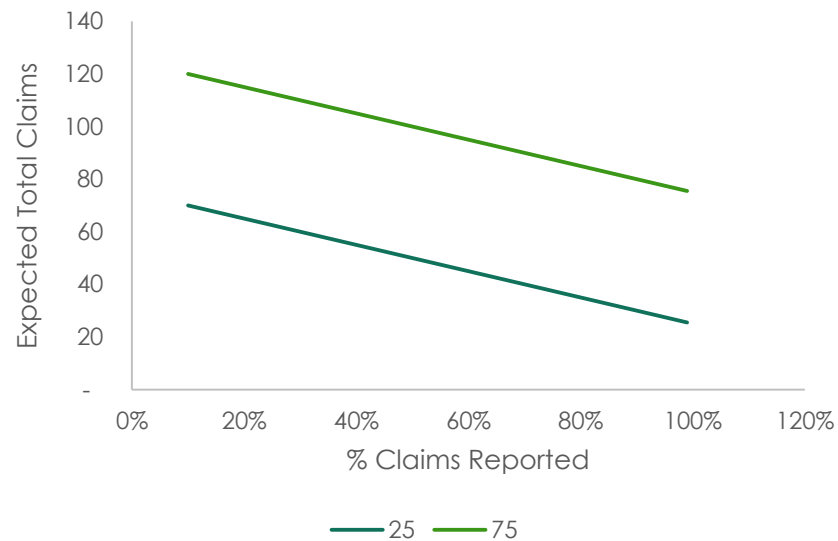
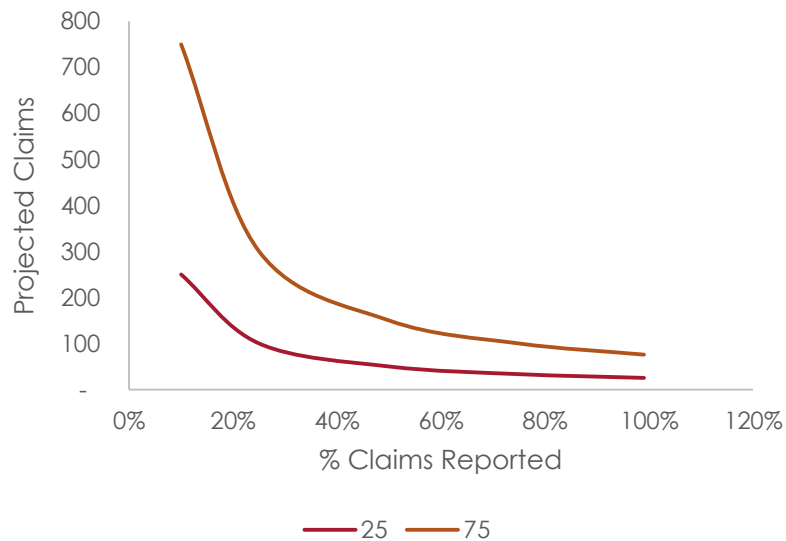
$$\text{Unreported} = \frac{(1 - F(\text{Days}))}{F(\text{Days})} \text{Reported}$$

# Slow Development



$$\frac{(1 - F(\text{Days}))}{F(\text{Days})}$$

$$\text{Total Claims} = \text{Reported Claims} + (1 - F(\text{Days})) \times E(\text{Claims})$$





# Overview of Process



Unreported Claims

$$\sum_{Days} \sum_{Perils} (E(\text{Unreported Claims} | Days, Peril) \times E(\text{Claim Amount} | Days, Peril))$$



+ Reported but not Authorised Claims

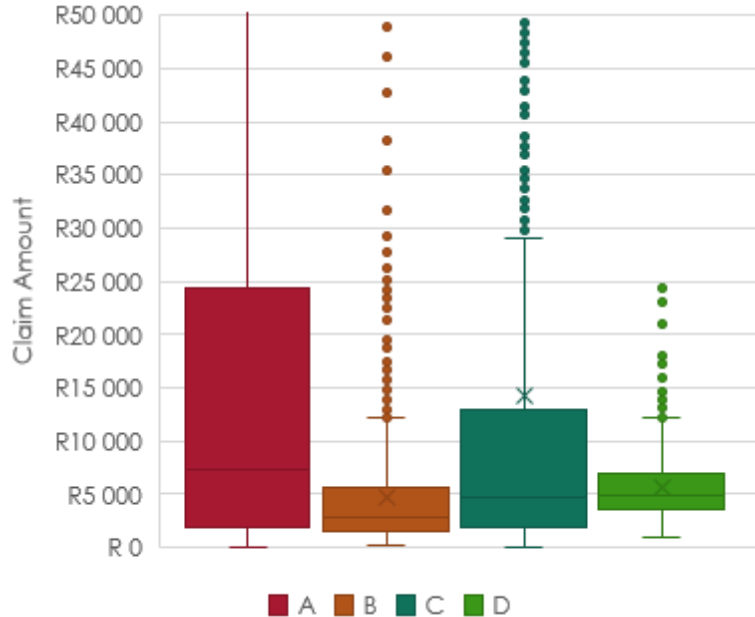
$$\sum_{Claims} E(\text{Claim Amount} | Peril)$$



+ Authorised but not Settled Claims

$$\sum_{Claims} (\text{Case Estimate}) \times E(\Delta \text{ from Estimate} | Peril)$$

# Expected Claim Amount



## Model Structure:

$$\sum_{\text{Cost Type}} P(\text{Cost Type}) \times E(\text{Amount} | \text{Cost Type})$$

$$P(\text{Cost Type}) \sim \text{BIN}(\alpha, 1)$$
$$\alpha = \exp(\eta) / (1 + \exp(\eta))$$

$$E(\text{Claim}) \sim \text{Gamma}(\alpha, \beta)$$
$$\alpha = \exp(\eta)$$

# Amount & Probability Impacts



	Global Estimate	Initial Case Estimate	Final Case Estimate
<b>Asset Details</b>	Y	Y	Y
<b>Policy Details</b>	Y	Y	Y
<b>Claim Details</b>	Y	Y	Y
<b>Assessment Details</b>	N	Y	Y
<b>Provider Details</b>	N	N	Y

# Overview of Process



Unreported Claims



$$\sum_{Days} \sum_{Perils} (E(\text{Unreported Claims} | Days, Peril) \times E(\text{Claim Amount} | Days, Peril))$$



+ Reported but not Authorised Claims



$$\sum_{Claims} E(\text{Claim Amount} | Peril)$$

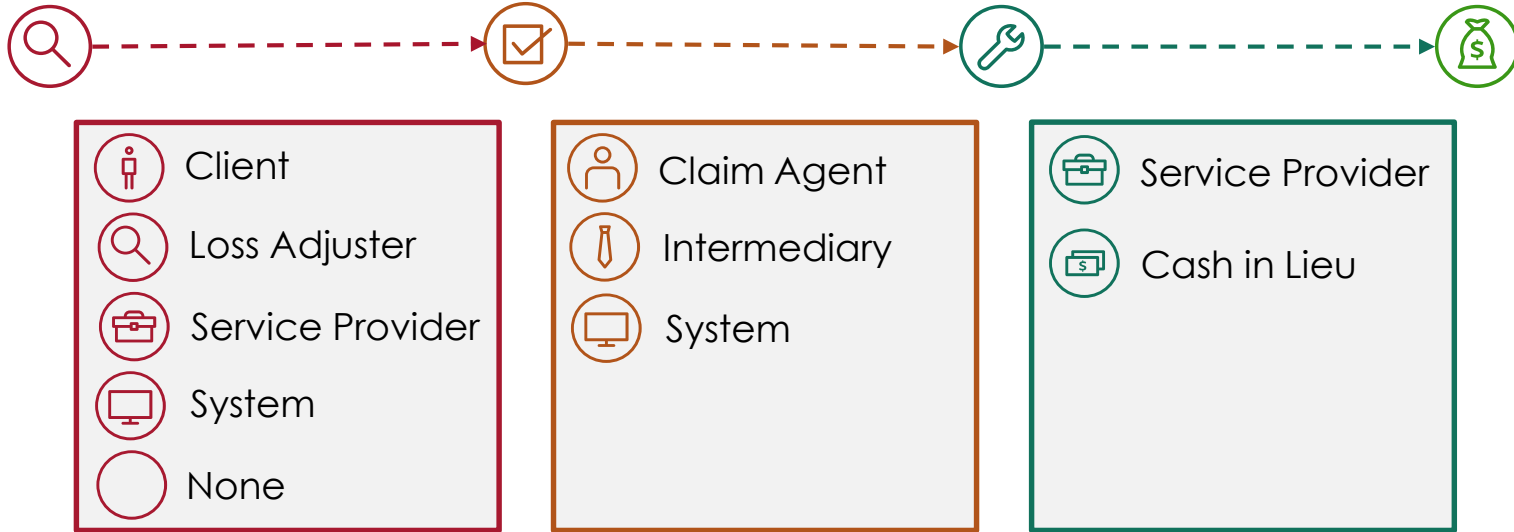


+ Authorised but not Settled Claims



$$\sum_{Claims} (\text{Case Estimate}) \times E(\Delta \text{ from Estimate} | Peril)$$

# From Case Estimate to Final Payment



## Model Structure:

$$\Delta \text{ from Estimate} = \frac{\text{Final Amount}}{\text{Case Estimate}}$$

$$\Delta \text{ from Estimate} \sim \text{Gamma}(\alpha, \beta)$$

$$\alpha = \exp(\eta)$$

# Overview of Process



$$\sum_{Days} \sum_{Perils} (E(\text{Unreported Claims} | \text{Days, Peril}) \times E(\text{Claim Amount} | \text{Days, Peril}))$$



$$\sum_{Claims} E(\text{Claim Amount} | \text{Peril})$$



$$\sum_{Claims} (\text{Case Estimate}) \times E(\Delta \text{ from Estimate} | \text{Peril})$$

# Benefits of the Approach

## ⊕ Advantages

- Single modelling process needed with minor touch-ups
- Increase liquidity management
- Identify efficient providers
- Real time tracking of reserves
- Leverage off of work done by pricing team

## ⊖ Drawbacks

- Will struggle with claims with long reporting delays
- Granular data is needed
- Significant Effort
- Out of the norm... making peer review/audit challenging

# Summary

## Current Reserving Methods Place Extensive Reliance on Triangles

- These triangles can be **improved** by incorporating linear modelling into the process.
  - Follows existing processes
- Or triangles can be **replaced** by state dependent estimates
  - A lot of the information is already available



# Thank You

## Questions?



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